Unit 4

Harvesting and Storage

INTRODUCTION

Harvesting is an important operation in crop production. But the yield is often lost due to inappropriate harvesting and threshing practices. Some varieties of rice tend to ripen non-uniformly, especially, under irrigated conditions. Also, frequent rains and lack of continuous sunlight during the harvesting period make harvesting of the crop difficult. Grains, even on the same panicle, ripen at varying rates. Early harvesting may carry green grains and cause rotting. On the other hand, late harvesting of the crop leads to over ripening of the grains and shattering losses. Furthermore, unnecessary delay exposes the grains to increased bird attack, which may also adversely affect the yield and total produce.

Harvesting the crop at appropriate time is important to check crop loss and maintain quality grains, which implies high market value for the produce. The crop must always be harvested at physiological maturity or harvest maturity. The harvest time also affects the germination potential of paddy seeds. After the harvesting of paddy crop, it must be threshed immediately to maintain the quality of the grains. Over drying of harvested paddy for several days must be avoided as it affects the grain quality. It is advisable to clean the grains for packaging and storage purposes.

HARVESTING, THRESHING AND WINNOWING

Harvesting

It is one of the most important phase of crop production, wherein, ripened crop is collected from a field. Harvesting, therefore, implies cutting and collecting mature crop from the field. The processes sequentially involved in harvesting are reaping, stacking, threshing, cleaning, packing and hauling. These processes can be done either manually or mechanically. Application of recommended harvesting methods can help maximise the yield and improve the quality of grains, thereby, minimising grain damage, loses or deterioration.

Before a farmer plants the crop, one must decide how and when to till the field. Tilling prepares the soil so that the seedlings can be planted. Tillage begins after the last crop is harvested.

Points to note

- At about 35 days after flowering, it is time to start thinking of harvesting the paddy crop.
- Green grains should not be more than four to nine per cent at harvest time.
- Grains at the milky stage should normally be less than one per cent.

Time and stage for harvesting

Timing in harvesting operation is important to achieve high market value of the produce with a high consumer acceptance. When approximately 80 per cent of the panicles turn golden yellow and the grains contain about 20 per cent moisture, it is the right time and stage for harvesting [Fig. 4.1(a) and (b)].

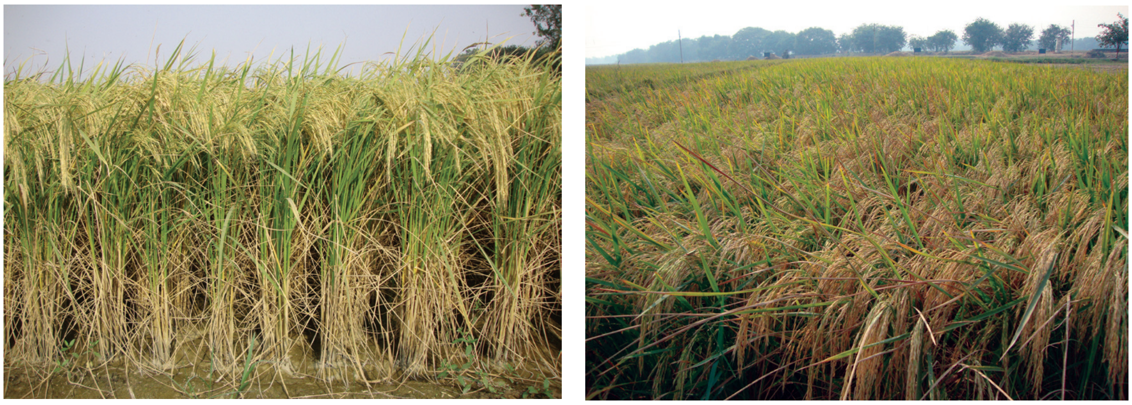

(a) (b)

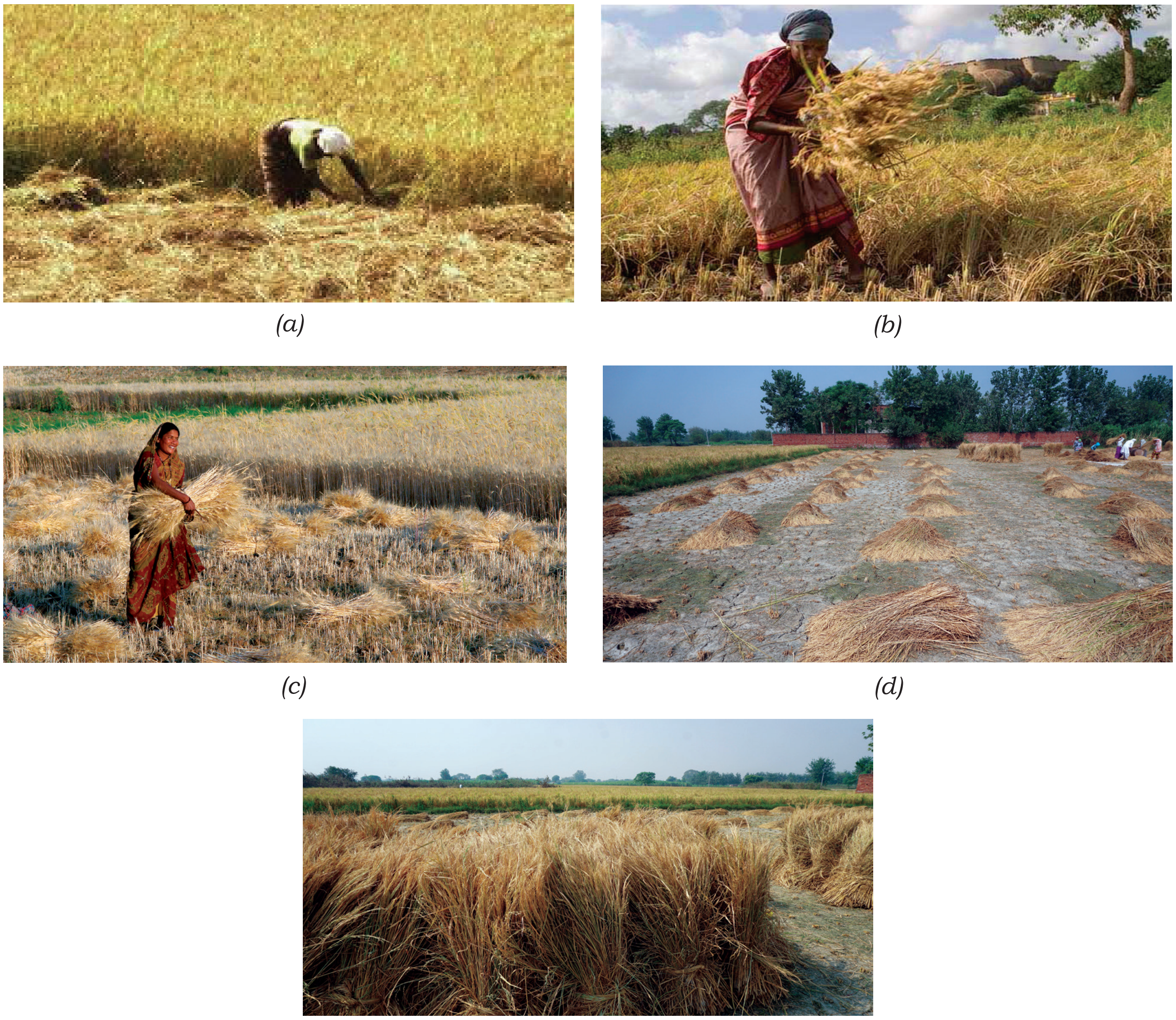
Fig. 4.1 (a) and (b) : Stage of harvesting

Methods of harvesting

Harvesting can be carried out manually, as well as, mechanically. Combine harvesters are now widely being used for harvesting of paddy crop. Using combine harvesters is efficient than manual methods of harvesting. The time required for carrying out the entire operation with the help of combine harvesters reduces by 70–75 per cent compared to manual methods.

Manual harvesting

Manual harvesting is the most popular method of harvesting paddy crop in India. This method is in practice for centuries. Paddy crop is cut with the help of sickles at a point, leaving about 15–20 cm culm into the ground. The sickle to be used must be sharp and serrated. Using sickle for cutting paddy crop needs



(a) *(b)*

(c) *(d)*

(e)

Fig. 4.2 (a to e) : Stages of manual harvesting expertise so that fingers, thumb and skin do not get injured in the process [Fig. 4.2(a to e)]. While cutting the crop with a sickle, one must always hold the stems with the thumb, pointing upwards (away from the blade).

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Advantages

Hand or manual method of harvesting has the advantage of ease of operation. There is no other alternative for harvesting paddy under lodged crop conditions. When other means are not affordable or weather conditions do not permit the use of mechanical methods, then manual methods are suitable.

Disadvantages

It is a labour intensive and time-consuming process, subject to weather conditions. It requires five to ten people to carry out the work manually.

Mechanical harvesting

Harvesting by reaper

Crop cutting machines used for reaping (machines that cut and gather) are called 'reapers'. These machines are useful in carrying out harvesting on small land holdings and may be hand-driven, mechanised or tractor-mounted. Most reapers lay the crop row-wise aside the re aper line (to be picked up later). The cutting width of reapers is, generally, 1.5 metre and they can deliver harvest to the extent of 2–4 ha/day. Their efficiency goes up if the fields are leveled and dry. Water must be drained out 10–15 days before starting the harvesting operation.

Combine harvesting

Combine harvester is a machine, which is more efficient than any other method of harvesting and combines all operations, such as cutting the crop and feeding it into a compact sequential process (reaping, threshing, cleaning, packing and transferring it to packing or storage bags or bulk wagon). The cut up straw is, usually, discharged behind the combine in a windrow and can be piled up safely for various uses later.

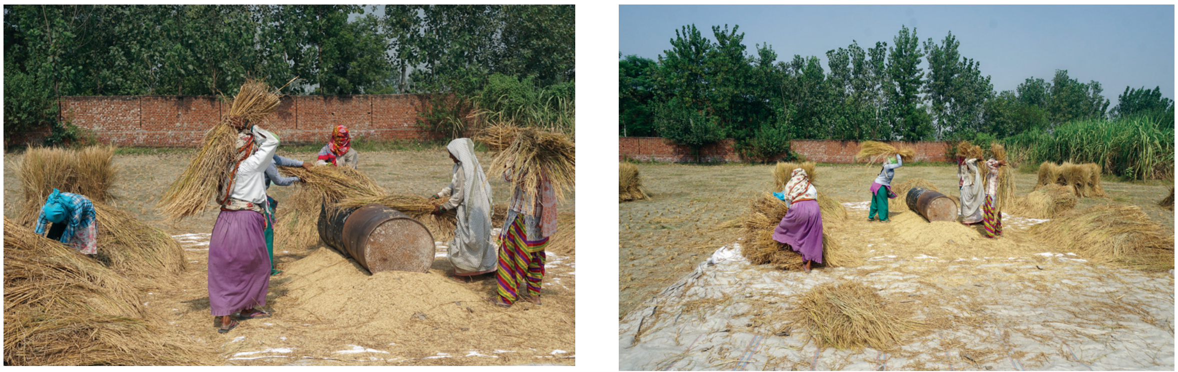
Threshing

It is the process of separating grains from a straw. It is done by stacking small bundles on a platform or using mechanised equipment. Pedal threshers are also being used these days. Heavy duty power-driven stationary threshers are used for quick large-scale threshing. Threshing can be done both manually and mechanically.

Manual threshing

Trampling

It is an ancient and traditional method of threshing, wherein, farm animals like bullocks are made to walk in the field and trample the crop bundles spread loosely over a mat, tarpaulin or canvas with their hoofs. It is carried out either in the field itself or in the village compound, which, generally, has a threshing floor. After the grains are separated from the straw, they are cleaned by winnowing with or without the help of a winnower (man-operated fan, mechanically or electrically operated fan; see [Fig. 4.3 (a) and (b)].



(a) *(b)*

Fig. 4.3 (a and b): Manual threshing

Threshing table or rack

The harvested sheaves (stalks with panicles on top) are held by hand and beaten against a slatted bamboo, wooden or any hard stationary object *viz.*, steel or empty oil drum. As a result, the grains come out of the panicles and get collected on the ground. This is a labour-intensive process. However, varieties with easy thresh ability make the process easier.

Pedal thresher

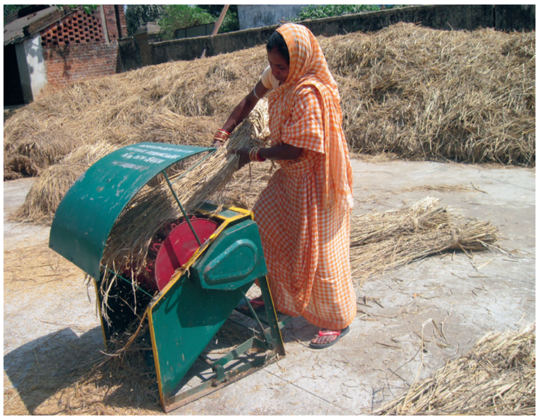


Fig. 4.4: Manual paddy thresher

The constituents of a pedal or treadle thresher include a threshing drum, transmission unit, foot crank and base (strong and stable). When pedaled, the drum rotates and functions as a threshing drum. Holding the crop against the rotating drum with spikes or rasp bars of the thresher operated manually or electrically is better than a human powered one. The threshed material contains small straws, chaff and foreign matter. These must be further separated by winnowing and sieving.

Mechanical threshing

Use of portable threshers is perhaps the first step in the introduction of mechanical threshing for paddy crop. Its major advantage is ease of operation and reduction in the labour required. Stationary or immovable threshing is, generally, done in the field or near the field. Also, there is an option of using a pedal thresher, a tool used to improve manual threshing.

Small stationary machine thresher

This machine has mostly replaced manual threshing. Mechanical threshers are kept in the field or close to it. The rotating drums constitute the threshing component in the threshers. These may be peg toothed or blade toothed (wire loop or rasp bar type; see Fig. 4.5).

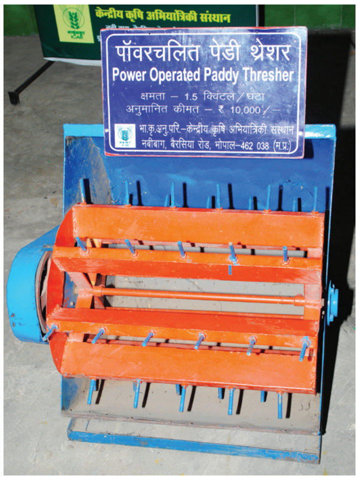

केन्द्रीय कृषि अभियांत्रिकी संस्थान
पॉवरचलित पेडी थ्रेशर
Power Operated Paddy Thresher
क्षमता – 1.5 क्विंटल / घंटा
अनुमानित कीमत – ₹ 10,000/–
भा.कृ.अनु.परि.–केन्द्रीय कृषि अभियांत्रिकी संस्थान
नबीबाग, बैरसिया रोड, भोपाल–462 038 (म.प्र.)

Fig. 4.5: Power-operated paddy thresher

Large machine thresher

It has the added advantage of cleaning devices like an oscillating screen, centrifugal blower and wind board. Threshed grains, in this case, do not demand further cleaning. In many locations, machine threshers are available on custom hiring basis. Many of these custom hired machines are tractor driven, which enable the operator to cover field-after-field as per the schedule.

Guidelines for threshing

- Put the harvested crop for drying on a safe surface. The dried crop material must not be re-wet as it is harmful.

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- Less the moisture content in grains, less is the grain loss in threshing. Best results are obtained at 18–20 per cent grain moisture content.

Combine threshing

It is a machine that combines a series of operations, starting from reaping up to packing in bags, and removing stalks and unwanted material from harvested grains (Fig. 4.6). In India, the use of combine harvesters (or simply, 'combines') has increased rapidly over vast areas. A shift from manual or other mechanical means has been triggered by labour shortage and consequent increase in harvesting cost, which makes the use of combines economically attractive.

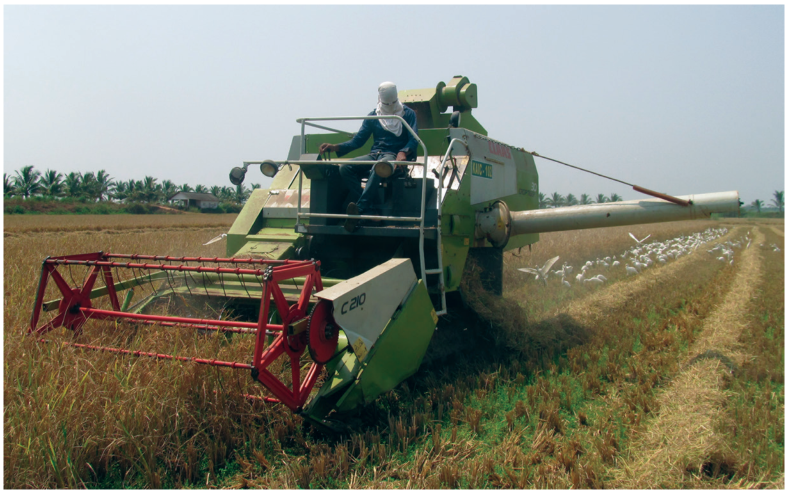

Fig. 4.6: Combine harvester used for threshing

The functions a combine harvester performs are as follows.

- Reaping: Cutting the crop above the ground surface after leaving about 15–20 cm clumps into the soil.
- Threshing: Separating grains from rest of the cut crop.
- Cleaning: It involves removal of immature, unfilled and non-grain material.
- Bagging: It involves packing threshed grains into bags for storage or transportation. Sometimes, the threshed grains are simply poured into an open

trolley for direct transportation, if bagging is to be avoided, or in case, not considered necessary.

- Hauling: It entails moving the cut crop material to a desired location for threshing.

Notes

Cleaning or winnowing

It refers to the removal of lighter material, such as unfilled grains, chaff, weed seeds and straw from grains with the help of blower, air fan or wind. Winnowing retains only the heavier grains.

Sifting or screening

Weed seeds, undefined hard material or soil particles (1.4 mm or less), if any, are removed by sieving.

Winnowing procedure

- Place a sheet or mat on the ground.
- Put grains on a winnowing tray.
- Tilt the tray from a height of about 1.5 to 2 metre to let the grains fall against the wind, so that light grains can be separated and pushed away from heavy grains.
- Collect only the heavier grains.
- Repeat the procedure, if required.
- A fan or blower is recommended, if sufficient wind is not blowing.

Storage of paddy

A grain storage facility is required to provide congenial conditions for the safety and long life of stored material. It implies prevention of loss by adverse weather conditons, moisture, rodents, birds, insects, microorganisms or pilferage. During storage of paddy (with husk), husk provides protection against insects and also helps check deterioration of grain quality, etc. Hulled rice occupies 20 per cent less storage capacity. Under tropical humid conditions, brown unpolished rice has a short shelf life (of about two weeks).

Table 4.1: Problems associated with the storage of grains with different moisture content

Grain moisture content (%)	Safe storage	Problems
14 or less	3 weeks to six months approximately	Fungal growth, discolouration and respiration loss
13 or less	8 to 12 months	Damage by insects
12 or less	Farmer's seeds	Loss of germination
9 or less	More than 1 year	Loss of germination

Source: Rice Knowledge Bank, International Rice Research Institute (IRRI), Manila, the Philippines

What does safe storage imply?

Safe storage implies preventing or minimising the entry of moisture into the storage area and grains. Rice grains having high moisture content may get spoilt in storage. Some of the points that need to be taken care of for the safe storage of grains are as follows.

- Safety against insects–pests, rodents, birds, etc.
- Ease of loading and unloading within and outside the storage premise.
- Efficient use of storage space for placing and retrieval of stocks.
- Electricity and water supply with ease of maintenance and management.

Rice storage facilities

Storage systems can be in open, bulk, sealed (hermetic) containers or bags. Rice storage facilities may vary according to the quantity to be stored, purpose of storage, location, etc.

Bag storage

This implies storing grains in 40 or 80 kg jute or woven plastic bags. In a rural setting, any kind of large vessel becomes a storage material.

Bulk storage

A common storage material used in India is a jute bag or woven plastic bag (40 or 1000 kg capacity). Depending on the size of storage, these bags are, normally, arranged into stacks.

Hermetic storage

Grains are stored in an airtight container so that moisture content of the stored grains remains unchanged. This system helps increase the life of seeds, maintain high germination rate and control stored grain pests.

Some of the points that need to be taken care of while storing rice grains are as follows.

- The dimensions and design of the storage must be amenable to sealing and fumigation. Do not stack bags one over the other to a height exceeding 4 metre for jute bags and 3 metre for plastic bags (less stable and prone to slippage).
- Provide a year-round water-proof facility at roof and enclosure (concrete, asbestos, tarpaulins or polythene covers).
- A 15–cm clearance must be provided from the ground (with a plank device), and likewise, a 1.5–metre clearance must be maintained between the top of the stack and roof. Sufficient walking space is also needed, say a one–metre gap between and around stacks.
- Do not use an accessory or material (for example, paddy straw or old bags) that may be prone to inviting insects–pests, diseases, spores, etc.
- A hermetic liner bag may be used, especially, for storing seeds. The bag may even be used for storing commercial paddy and rice grains.
- These must be designed to cater to intermittent marketing schedules and plans.

NOTES

Maintaining hygiene in storage

- Keep the storage areas clean by sweeping the floor, removing cobwebs, dusting and removing bird spills, if any.
- After emptying the storage rooms, clean the space. It is advisable to spray the walls, crevices and floor with an insecticide. Also, fumigate these areas before using them for storage again.
- The storage rooms must be kept free of vermin.

- Periodic inspection of stored seeds is recommended for signs of infestation. If necessary, corrective measures must be taken immediately.

Practical Exercise

Activity 1

Visit a nearby paddy field and observe harvesting and threshing process being carried out there.

Material required: notebook and writing material

Procedure

- Visit a nearby paddy field, where crop has reached the maturity stage.
- Observe and note down the colour of the panicles and plant, hardness of grains, etc.
- Observe the harvesting process.
- Observe if the harvesting process is being carried out manually or a harvester is being used.
- Note down the functions of the harvester.
- Also, note down the steps being followed in case manual harvesting is being carried out there.
- Present your findings before the class.

Activity 2

Visit a nearby warehouse and observe the storage of rice grains.

Material required: notebook and writing material

Procedure

- Visit a warehouse in your area.
- Observe and note down the method being followed there to store rice grains.
- Discuss with the store manager the measures being followed there to store the grains safely.
- Present your findings before the class.

Check Your Progress

A. Fill in the Blanks

1. The process of cutting and collecting mature crop from the field is known as _________.
2. The right stage of harvesting paddy crop is when most of the panicles turn _________ in colour.
3. The process of separating grains from straws is called ____________.
4. Generally, paddy crop is ready for harvesting after _________ days of flowering.

5. Rice grain with its hulls removed but not polished is called __________.
6. When grains are too moist, it may result in ________ during storage.
7. Rice grains may be stored for more than one year with the moisture content of ________ per cent or less.

B. Multiple Choice Questions

1. Drain the rice field ________ day(s) before harvesting.
   (a) one
   (b) five
   (c) seven–nine
   (d) 10–15
2. Which of these combinations identify the first and last activity in the process of harvesting?
   (a) Reaping and cleaning
   (b) Reaping and handling
   (c) Reaping and stacking
   (d) Reaping and hauling
3. The appropriate time for harvesting of paddy crop is when the grain moisture content reaches below ____________ per cent.
   (a) 10
   (b) 20
   (c) 30
   (d) 40
4. The process of separating unfilled grains, chaff and straws from the grains is known as ____________.
   (a) reaping
   (b) winnowing
   (c) threshing
   (d) hauling
5. What is the shelf life of unpolished brown rice under tropical conditions?
   (a) One week
   (b) Two weeks
   (c) Three weeks
   (d) Four weeks
6. What is the optimum capacity for bag storage?
   (a) 20 or 40 kg
   (b) 30 or 90 kg
   (c) 50 or 100 kg
   (d) 40 or 80 kg

C. Subjective Questions

1. Write the different stages of paddy crop harvesting.
2. Discuss the methods of paddy crop harvesting.
3. Describe threshing and its methods.
4. Define storage and explain various rice storage facilities.
5. Write in brief how you will maintain hygiene in the storage of rice grains.

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D. Match the Columns

A	B
1. Machine threshing	(a) Shatter loss
2. Pedal thresher	(b) Winnowing
3. Cleaning	(c) Mechanical threshing
4. Late harvesting	(d) Better than manual threshing
5. Hermetic storage	(e) 20 per cent less storage capacity
6. Hulled rice	(f) Made of jute
7. Storage bag	(g) Airtight containers